Design and Analysis of Fractal Antenna

Dileep Kumar[1], Dr. Priyanka Jaiswal[2]

[1]*Master of Technology, Electronic and Communication Engineering, GITM, Lucknow, India*
[2]*Professor, Electronic and Communication Engineering, GITM, Lucknow, India*

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Abstract - *The design suggestions for three antennas, each of which has a whole separate set of capabilities. The idea of fractal geometry is used by all three in the process of constructing small antennas that have superior performance than that of Microstrip Patch antennas (MPAs). Fractals are now one of the most fruitful areas of study in the world of antenna design. Their most notable advantage is their capacity to increase electrical length while basically maintaining the same amount of area and delivering improved performance. The first idea is to create a hybrid fractal, which combines elements from two different kinds of fractals—the Sierpinski Carpet and the Giuseppe Peanu—and superimposes them on top of one other in order to provide the antenna the capability of narrow-band operation. Due to its ability to resonate in the S-band, it carries with it the potential to be used for WiMAX applications. The second idea is to use an iterative self-similar design to create a multi-band fractal, which is the second part of the second proposal. The antenna achieves its multi-band capabilities by cutting circles out of squares while preserving electrical conductivity throughout. The fact that it can resonate at five different frequencies within the range of three gigahertz to twelve gigahertz gives it a wide variety of potential uses, all of which are feasible within this frequency range. The third suggestion is to use an antenna with a very wide band, the manufacture of which has already been completed. The smallest of the three patches, this one was designed by cutting hexagonal holes out of a circular patch, and optimization was accomplished via the use of parametric analysis.*

Key Words: Design, Analysis, Fractal, narrow band, multi-band, ultra wide band, antenna.

1. INTRODUCTION

One of the most fundamental justifications for the statement is the revolution that has occurred in the sphere of communications. Wireless communication [1] refers to the transmission of data between two or more locations that are not connected by electrical conductors. This is one of the fastest growing segments in the above areas. It provides solutions to a variety of difficult and unpleasant conditions, including: B. Cable laying in mountainous areas or long distances. By using a mobile phone, you can save yourself the trouble of carrying a wired device at home or at work, and you can now communicate anytime, anywhere. WLAN (Wireless Local Area Network) innovation permits clients to interface with the Internet without the requirement for excess and costly rapid links, and is broadly perceived as an adaptable and savvy option in contrast to conventional fast information transmission. One of the critical main impetuses behind this has been the consistent craving for pocketsized and open specialized gadgets, also the effortlessness of plan and assembling. Because of the developing interest for consistent coordination of cell organizations, for example, 3G, GSM, WPAN and WLAN, it is broadly accepted that future remote organizations will fundamentally incorporate short-range high velocity remote administrations as a fundamental component. The fast development of remote interchanges has prompted the inundation of new gadgets and frameworks intended to satisfy the developing need for sight and sound applications. Little universally useful radio wires need to endure the heap that addresses the issues of cell phones and remote organizations, so they need to have high addition, wide data transfer capacity, inserted establishment, etc.

1.1. Fractal Antenna

A fractal antenna is a device that employs a fractal, self-comparative plan to upgrade the edge (on inside parts or the outside structure) of material that can get or communicate electromagnetic radiation inside a given all out surface region or volume. Staggered and space filling bends are different names for fractal radio wires, however the essential component is the repeat of a topic north of at least two scale levels, or "cycles." thus, fractal receiving wires are minuscule, multiband or wideband, and have applications in cell and microwave correspondences. The reaction of a fractal receiving wire shifts essentially from that of ordinary receiving wire plans in that it might work with great to-brilliant execution at a few frequencies simultaneously.

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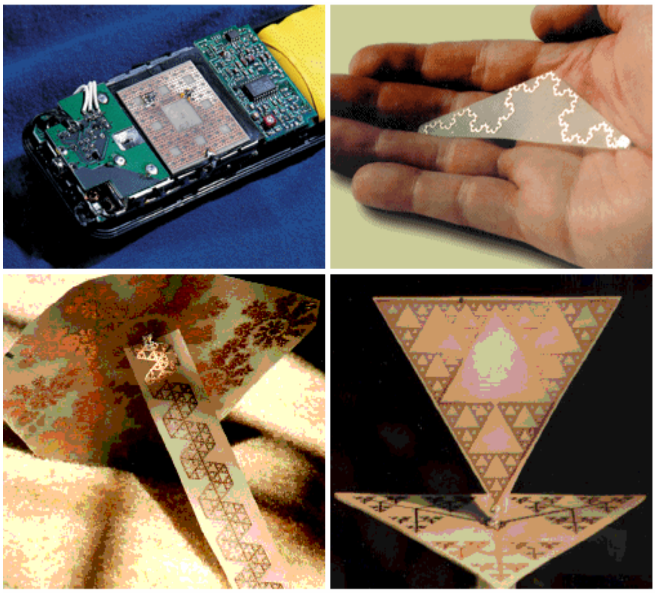

Figure-1: Fractal Antenna

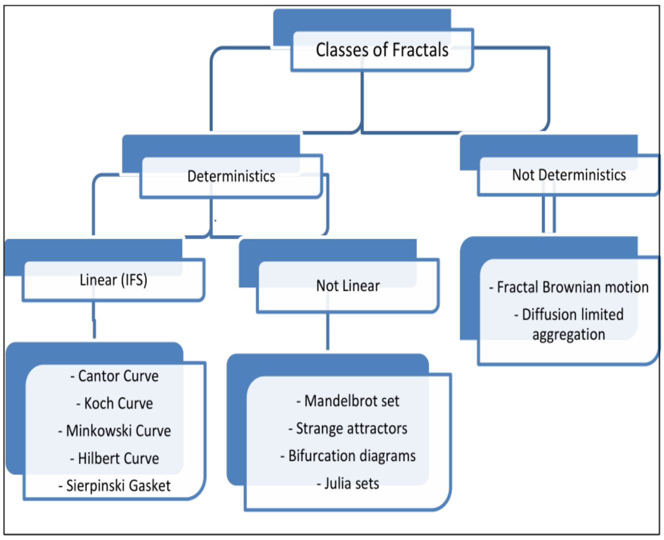

Figure-2.: Classes of fractals

2. NARROW BAND ANTENNA OF FRACTAL.

for example 12.5 mm, the proposed plan incorporates a sticking the component square shape is introduced to Giuseppe Peanu Fractal Slits, subsequently framing the premise of the round Sierpinski opening course of action. The substrate is made of low-cost fibreglass that is 1.6 mm thick and coated with. A rectangular piece of 3mm X 25mm serves as the ground.

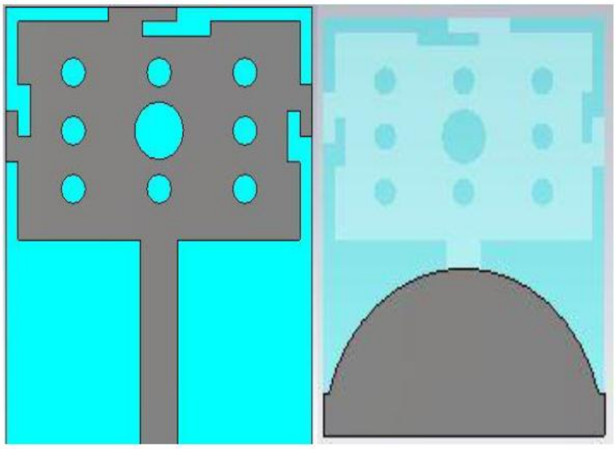

Figure-3: front and backside view.

Table-1.: Design Parameter Dimension.

Serial Number	Parameter	Value
1	Length of substrate	30mm
2	Length of patch (front)	16 mm
3	Length of patch (back)	3 mm
4	Centre of circle (back)	(0,-16)
5	Radius of bigger circle	2mm
6	Width of substrate	25mm
7	Length of notch on patch	W/3 or L/3
8	Width of notch	1mm
9	Center of first circle (front)	(0,6.5)
10	Radius of smaller circle	1mm

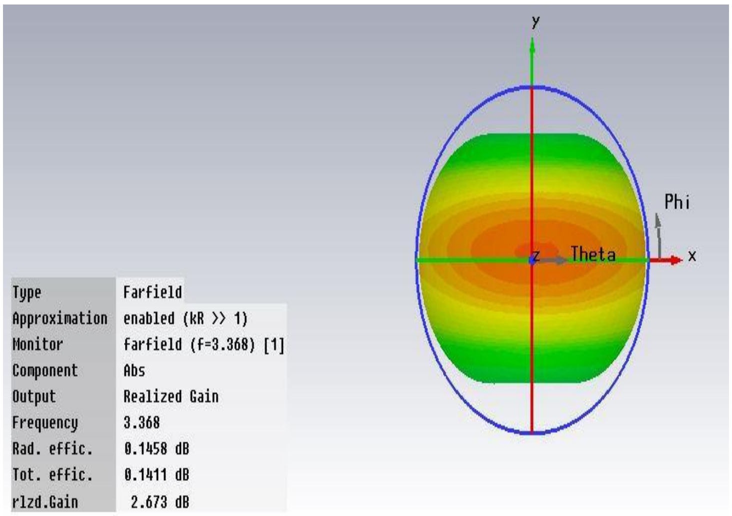

Figure-4: Gain of Realized.

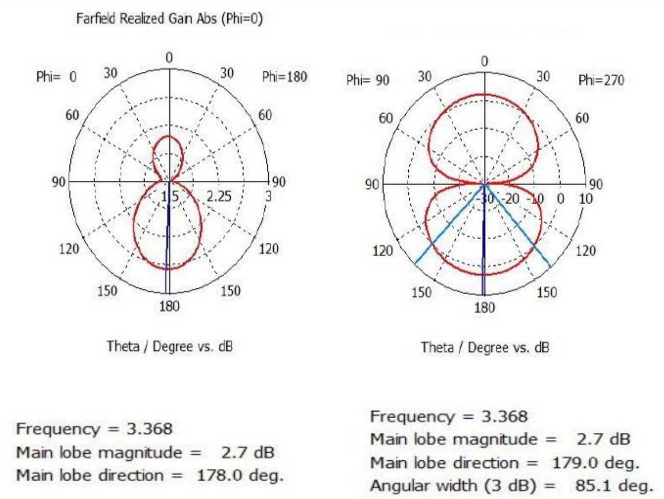

Figure-5: Patterns of Radiation.

3. MULTI BAND FRACTAL ANTENNA

The antenna is made by continually and iteratively cutting circles from squares with the dimensions given in the table below. The patchs are fed using the Co-Planar Waveguide-feeding approach, which is detailed in the table above. But first, here's how the antenna is designed.

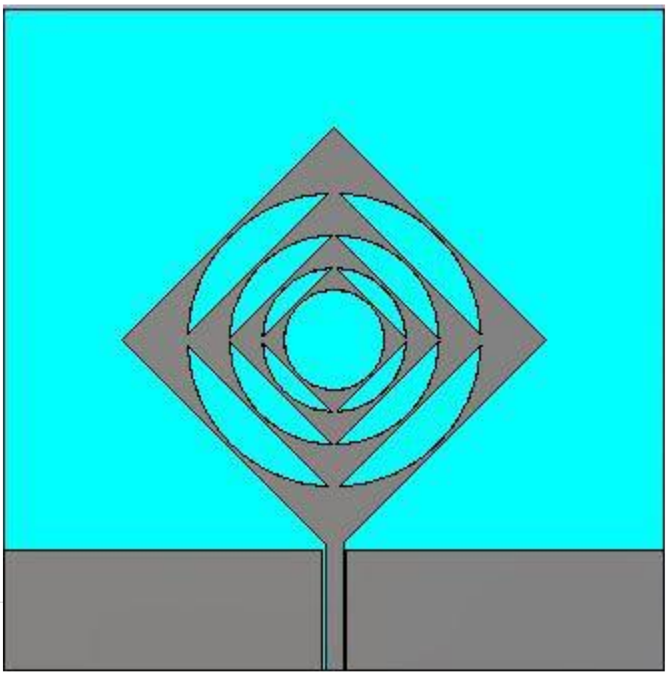

Figure-6: C.P.W-Fed Fractal.

Table-2: Dimension of the Circle and Square.

Iteration no	Length of edge of square.	Internal radius.
1.0	50 mm	24.5 mm
2.0	36 mm	17.5 mm
3.0	25 mm	12 mm
4.0	17.6 mm	8.4 mm

Table-3: Details Size Parameter of the design

S.no	Parameter	Value
1	Width = length of substrate.	110.0 mm
2	Thickness of substrate.	1.530 mm
3	Spacing between FEED and Adjacent Ground.	0.50 mm
4	Feed Length.	24.50 mm
5	Feed Width.	3.0 mm
6	Length of the C.P.W ground.	24.50 mm

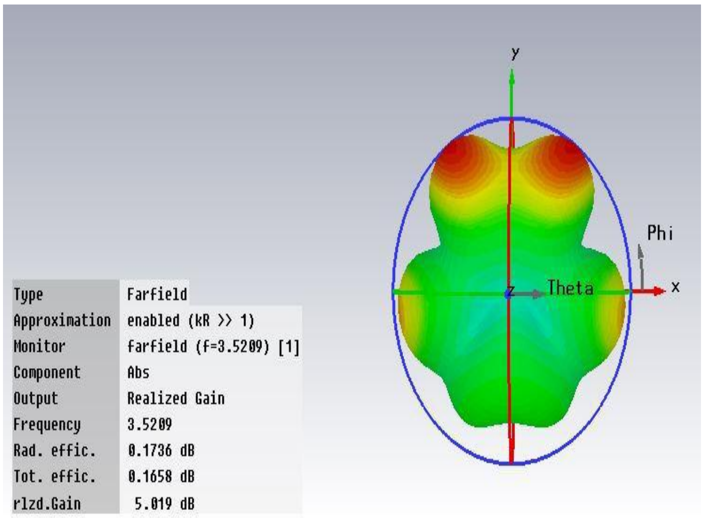

Figure-7: Gain of Realized (3D), When Fc= 3.52GHz.

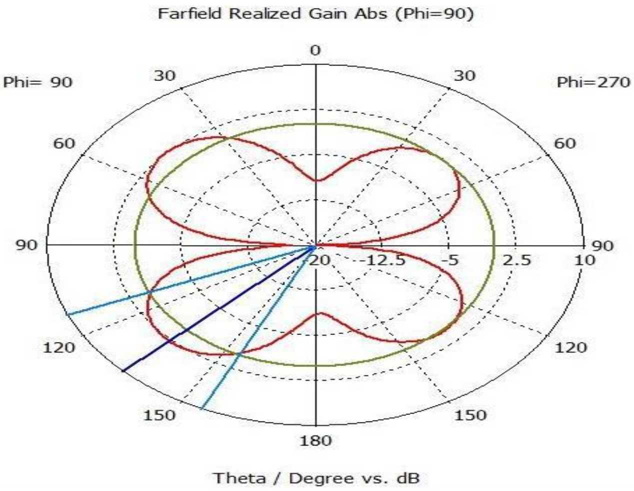

Figure-8: Patterns of Radiation.

4. ULTRA WIDE BAND FRACTAL ANTENNA

This operation is repeated five times, ensuring that electrical communication is maintained at all times. A CPW feed with the dimensions listed in table 5.2 is attached. The substrate is FR4, which has a di-electric stable of 4.4. Its measurements are in addition shown in the table above.

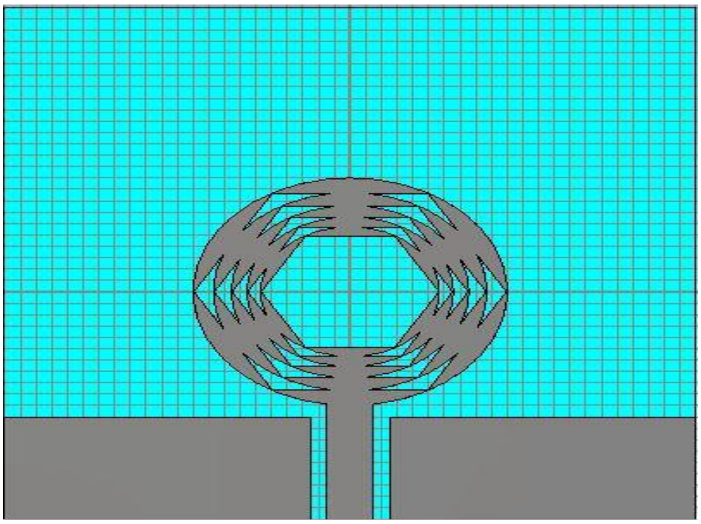

Figure-9: Proposed Design For Antenna.

Table-4: Design Parameter.

Serial Number	Radius of Outer Circle (in mm).	Length of sides of regular hexagon the regular
1.0	10.0 millimeter.	09.950 millimeter.
2.0	8.7060 millimeter.	08.6560 millimeter.
3.0	7.5740 millimeter.	07.5240 millimeter.
4.0	6.5830 millimeter.	06.5330 millimeter.
5.0	5.7170 millimeter.	05.6670 millimeter.

Table-5: Dimension Parameter for Antenna

Parameter	Length	Width
Feed-line.	11.50 millimeter.	03.0 millimeter.
Substrate.	45.0 millimeter.	44.0 millimeter.
Ground Patch.	9.0 millimeter.	19.50 millimeter.

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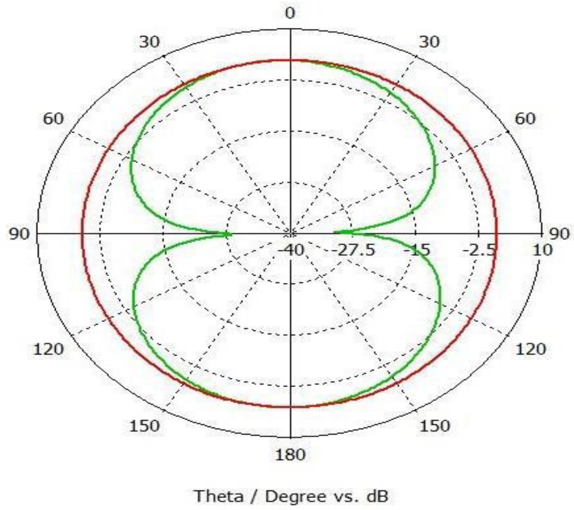

Figure-10: Patterns of Radiation, At fc= 3.7653 Gigahertz.

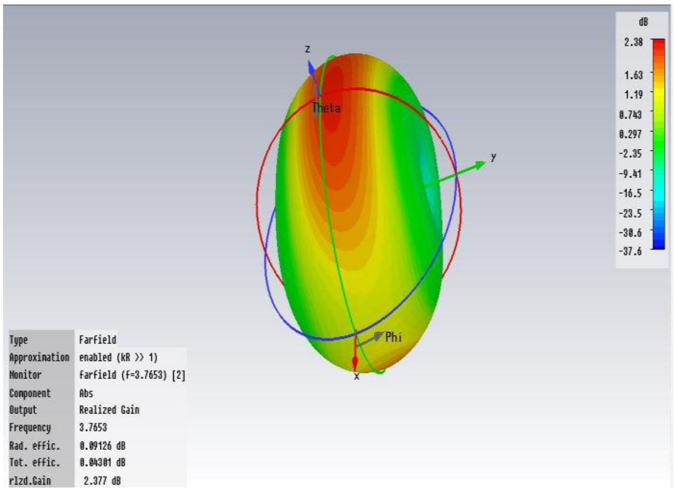

Figure-11: Realized-Gain (3-D).

5. CONCLUSION

The goal in writing this thesis was to better comprehend and contribute to the process of combining antenna theory with fractal geometry. It explains how to create Microstrip and Fractal antennas, as well as the theory behind them. Three designs have been proposed: a narrow-band, a multi-band, and an ultra-wide band, the last of which has been manufactured. The radiation and gain patterns of each have been extensively examined. In addition, the effectiveness of introducing fractal into antenna theory has been highlighted.

The study of a Fractal hybrid that demonstrated narrowband behaviour. The design began with a Giuseppe Peanu fractal, which served as the foundation for another fractal geometry, Sierpinski geometry. This antenna's Bandwidth Percentage was determined to be 40.421 percent, indicating that it is a narrowband antenna with a resonance frequency of 3.386 GHz.

It may be manufactured to use the attributes of the individual bands since resonant frequencies exist at numerous points over the SHF. It was a CPW-fed fractal created by iteratively carving out circles inside squares while maintaining electrical connection, on a dielectric substrate FR4 with a dielectric constant of 4.4 and no ground plane. The resulting antenna radiated at several frequencies in the SHF range (3.52 GHz, 5.7 GHz, 8 GHz, 9.95 GHz, and 12 GHz), making it multi-band capable.

An unique Ultra Wide-Band Application design that used hexagonal holes cut within a circular patch repeatedly over a FR4 substrate. It was CPW-fed, and the slot gap was optimised using parametric analysis. The antenna was also made from scratch. However, due to a lack of advanced equipment, measurements could not be carried out.

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